HADRON ATTENUATION IN NUCLEI

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The influence of the nuclear medium on the production of charged hadrons in deep inelastic scattering has been studied by the HERMES experiment at DESY using a 27.5 GeV positron beam. The differential multiplicity of charged hadrons and pions from nitrogen relative to that from deuterium has been measured as a function of the virtual photon energy ν and the fraction z of this energy transferred to the hadron. A substantial reduction of the multiplicity ratio $R_{^{14}N}$ at low ν and high z is observed. Moreover, a significant difference of $R_{^{14}N}$ is found for positive and negative hadrons.

Besides the study of the internal structure of the nucleon, deep inelastic lepton nucleus scattering offers a direct way to study the space-time development of the hadronization process, because one can use the secondary reactions of the final state particles for measuring the so-called hadron formation time τ_f [1]. At the HERMES energies nuclear effects may be significant since τ_f is of the same order of magnitude as the diameter of the target nucleus. In addition previous experiments performed at SLAC with deep-inelastic electron scattering [2], at CERN with high-energy muons by SMC [3] and with neutrinos by WA21/WA59 [4] indicate that the optimal energy range of the lepton to study hadronization dynamics with nuclei ranges from a few GeV to a few tens of GeV.

The quantity measured in the experiment is the attenuation ratio for the nitrogen $R_{^{14}N}$, defined as the ratio between the differential charged hadron multiplicity N$_h$ normalized by the number of scattered electrons N$_{DIS}$, for nitrogen (N) and deuterium (D) targets: $R_{^{14}N} = (\frac{1}{N_{DIS}}\frac{dN_h}{dzd\nu})_N/(\frac{1}{N_{DIS}}\frac{dN_h}{dzd\nu})_D$.

The attenuation ratio as function of z for charged hadrons and pions is shown in fig.1 (top). A significant attenuation of the hadrons is seen in the whole region $0.2 < z < 1$. The z behavior of the pion attenuation is similar to that of the unidentified hadron ones. It is worth noticing that the data cover the unexplored region $0.8 < z < 1$.

The hadron attenuation as a function of ν, for the two charge states, is shown in fig.1 (bottom) for hadrons and pions respectively. Since the attenuation of positive and negative pions is the same within the experimental uncertainties, the difference between positive and negative hadrons must be related to the difference in attenuation of the other hadrons, mostly protons

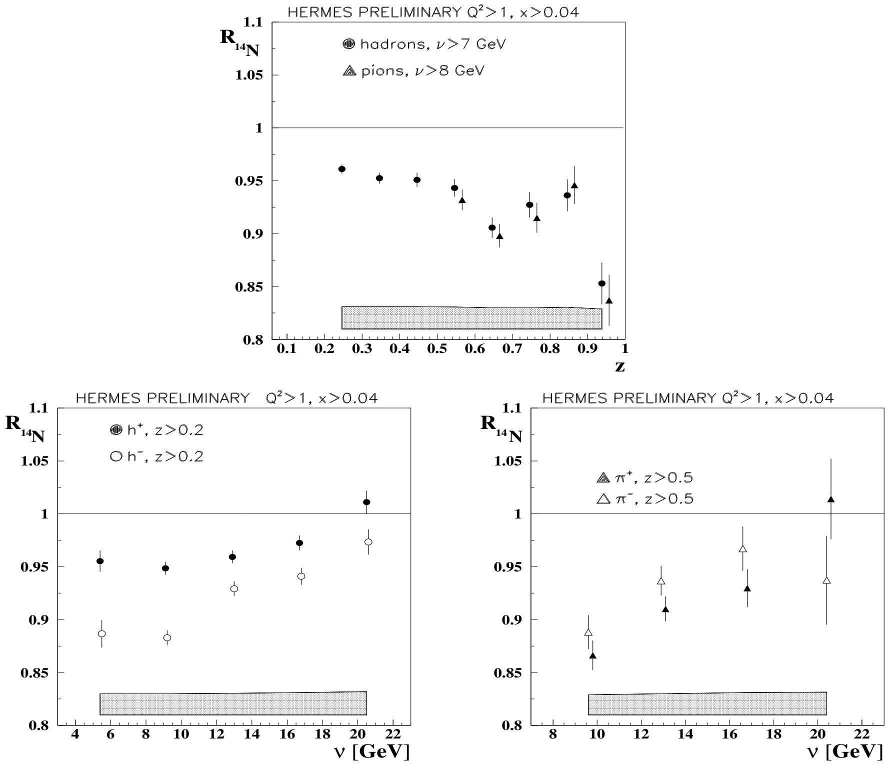

Figure 1: The attenuation ratio as function of z for charged hadrons and pions (top). The attenuation ratio as function of ν for positive and negative hadrons and pions (Bottom). The band represents the systematic uncertainties.

and kaons. This finding suggests that the proton attenuation is smaller with respect to the pion attenuation and therefore that the proton formation time in the hadronization process is larger than for lighter hadrons.

References

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